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Rahul Kakkar · S. Kumar · A. K. Singh

Cephalomedullary nailing for proximal femoral fractures

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Abstract From May 1999 to April 2002, we treated 14 patients with subtrochanteric femoral fractures and seven patients with ipsilateral fractures of the femoral neck and shaft using a second-generation cephalomedullary interlocked nail. Patients mean age was 36 (20–60) years, and 19 fractures were caused by high-energy trauma. Four patients had associated injuries. The average follow-up was 23 (16–30) months. Per-operatively, we had problems in locating the entry portal in four patients, and one nail was driven through the inter-condylar notch. All fractures except two united. One patient had non-union of the femoral neck and one of both neck and shaft. One patient united with shortening of more than 1.5 cm and varus angulation at the fracture site. Two patients had loosening and backing out of the proximal screw. The second-generation cephalomedullary nail is a suitable treatment option for proximal femoral fractures, but it requires a high degree of accuracy and technical expertise.

Résumé De mai 1999 à avril 2002 nous avons traité 14 malades avec une fracture fémorale sous-trochantérienne et sept malades avec une fracture ipsilatérale du col et de la diaphyse fémorale en utilisant un enclouage verrouillé céphalomédullaire de deuxième génération. L'age moyen des malades était de 36 ans (20–60). Dix-neuf fractures ont été causées par un traumatisme à haute énergie. Quatre malades avaient des blessures associées. Le suivi moyen était de 23 mois (16–30). Chez quatre patients il y a eu des difficultés de localisation du point d'entrée et, dans un cas le clou a été conduit dans l'échancrure inter-condylienne. Toutes les fractures, sauf deux, ont consolidé. Un malade avait une non consolidation du col fémoral et un autre une non consolidation du col et de la diaphyse. Un malade a consolidé avec un raccourcissement de plus de 1.5 cm et une angulation en varus au niveau de la fracture. Deux malades ont eu une mobilisation et un recul de la vis proximale. Le clou céphalomédullaire de deuxième génération est une option convenable pour le traitement des fractures fémorales proximales mais il exige un haut degré d'exactitude et de compétence technique.

R. Kakkar · S. Kumar · A. K. Singh
Department of Orthopaedic Surgery, Safdarjang Hospital,
New Delhi, India

R. Kakkar (✉)
Studio 318, 35 Rue du Dr Babinski,
75018 Paris, France
e-mail: rahulkaks@rediffmail.com

Introduction

Proximal femoral fractures (including subtrochanteric fractures and ipsilateral fractures of the femoral neck and shaft) have been an enigma for orthopaedic surgeons. Recently, the second-generation cephalomedullary interlocking nail has been advocated in these two categories of fracture [6–11, 14]. We report here our experience with this nail.

Materials and methods

From May 1999 to April 2002, 21 closed and complex proximal femoral fractures were treated at the Safdarjang Hospital, New Delhi, India. Fourteen patients had subtrochanteric fractures, and seven had ipsilateral fractures of the femoral neck and shaft. Open fractures were not included. There were 20 male patients and one female patient. The average age was 36 (20–60) years. The majority of fractures resulted from road traffic accidents, but there was also one pathological fracture. Four patients had associated injuries to other limbs, head and viscera. Subtrochanteric fractures were classified according to Russell–Taylor. There were three type IA, seven type IB, three type IIA and one type IIB fractures. The femoral neck fractures were classified according to Garden. There were three type II, three type III and one type IV fractures. The shaft fractures were classified according to Winquist–Hansen, and there were one type I, two type II, and four type III fractures.

We treated 14 patients with a Russell–Taylor reconstruction nail (Zimmer), six with a variation of the un-

Table 1 Patient characteristics. Subtrochanteric fractures were classified according to Russell–Taylor, shaft fractures according to Winquist–Hansen, and neck fractures according to Garden. *US* satisfactory union, *UU* unsatisfactory union, *NU* non-union, *N* femoral neck fracture, *S* femoral shaft fracture

Type of fracture	Interval to surgery (days)	Fracture type	Weeks to union	Result	Associated injuries	Complications
Subtrochanteric	8	IB	19	US	No	None
Subtrochanteric	8	IB	24	US	No	None
Subtrochanteric	6	IIA	18	US	No	None
Subtrochanteric	11	IB	20	US	No	–
Subtrochanteric	5	IA	19	US	No	–
Subtrochanteric	11	IA	20	US	No	None
Subtrochanteric	7	IB	14	US	No	–
Subtrochanteric	16	IB	22	US	No	None
Subtrochanteric	9	IB	18	UU	Yes	–
Subtrochanteric	16	IB	18	UU	No	–
Subtrochanteric	7	IIA	20	US	No	None
Subtrochanteric	8	IIA	18	US	No	None
Subtrochanteric	13	IIB	18	US	No	None
Subtrochanteric	16	IA	22	US	No	None
Femoral neck and shaft	12	S: III N: III	N: NU, S: 22	NU	No	–
Femoral neck and shaft	17	S: III N: IV	N: NU S: NU	NU	Yes	–
Femoral neck and shaft	15	S: I N: II	N: 15 S: 18	US	No	None
Femoral neck and shaft	7	S: III N: III	N: 20 S: 22	US	No	None
Femoral neck and shaft	2	S: II N: II	N: 14; S: 16	US	Yes	None
Femoral neck and shaft	4	S: II N: III	N: 16 S: 20	US	Yes	None
Femoral neck and shaft	7	S: III N: II	N: 16 S: 22	US	No	None

reamed femoral nail (Mathys) and one with the spiral blade variation of the un-reamed femoral nail (Mathys). In all cases, the procedures were performed by the technique recommended by the manufacturer. All nails were locked with at least one proximal and one distal screw. All procedures were carried out under image-intensifier control, but in two cases, we had to resort to open reduction because either the image intensifier failed or fracture reduction was impossible by closed methods. In four cases, we had difficulty in locating the entry portal, and in one case, the nail was driven through the inter-condylar notch.

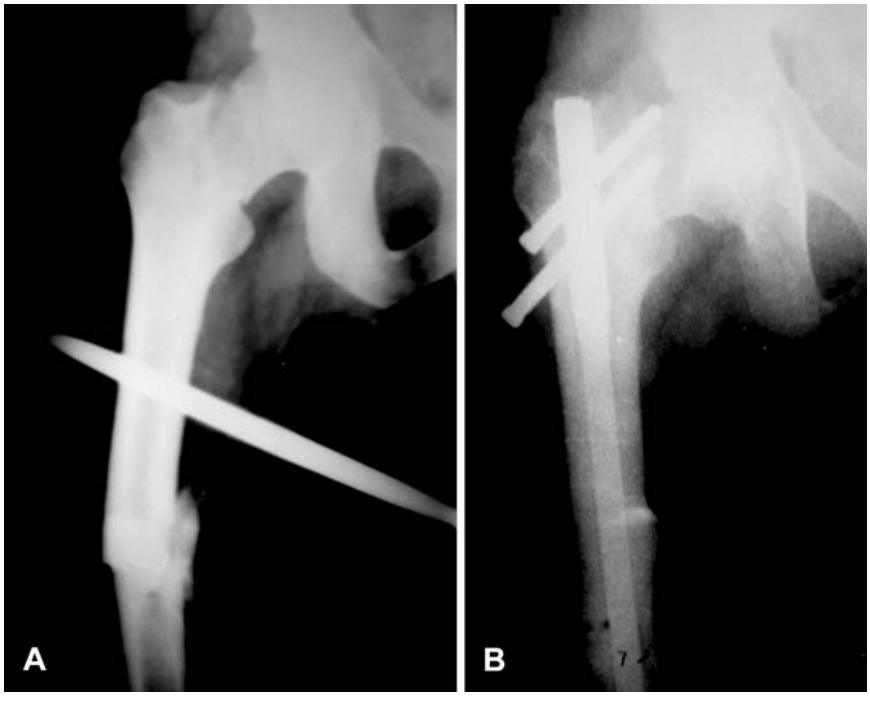

Fig. 1 **A** Ipsilateral femoral neck (Garden type III) and shaft fracture (type III) treated on the tenth day post-injury. **B** Radiograph showing non-union of femoral neck but union of femoral shaft at 14 months follow-up.

Results

All patients were followed up at monthly intervals. The average follow-up period was 23 (16–30) months, average operative time was 200 (150–270) min, and average pre-operative delay was 9 (2–17) days.

Radiological union was said to have occurred when solid bridging callus and trabeculae were seen to cross the fracture site. Clinical results were divided into three categories: *satisfactory union*—when union was achieved and there was no pain, no decrease in hip and knee joint range, no varus deformity and shortening was less than 1.5 cm; *unsatisfactory union*—when union was associated with pain, decrease in the hip and/or knee motion, any varus deformity or shortening greater than 1.5 cm; *failed*—when non-union occurred.

All subtrochanteric fractures united at an average time period of 19 (14–24) weeks, with 12 patients having a satisfactory union. In two patients, the result was classified as unsatisfactory. One patient had malunion in varus with shortening greater than 1.5 cm, loosening and backing out of the proximal screws. The other patient had hip pain on walking with a Trendelenburg gait and backing out of the proximal screws.

In the seven ipsilateral fractures of the femoral neck and shaft, all neck fractures were identified at the initial examination, but only in five cases was union of the femoral neck fracture achieved (Table 1). In two patients, there was non-union of the femoral neck (Fig. 1). In addition, one had non-union of the femoral shaft. The two patients were classified as failed. The average time to union for the femoral neck fractures was 16 (14–20) weeks and for the shaft fractures 20 (16–22) weeks. The non-unions of the neck were treated by posterior muscle pedicle grafting, and the non-union of the shaft was treated by dynamic compression plating.

Discussion

Proximal femoral fractures are usually the result of high-energy trauma and frequently have other associated injuries [8, 11, 14]. We observed four patients presenting with injuries to the viscera, thorax, head and other limbs in our series.

In patients with ipsilateral neck and shaft fractures of the femur, the femoral neck fracture is missed in 19–31% of cases [15]. In this series, no fracture was missed. Delayed treatment of femoral neck fractures has been correlated with an increased incidence of non-union and avascular necrosis; however, Bennett et al. [2] reported no incidence of avascular necrosis in 37 cases of which 50% were treated after a delay of more than 1 week. The two patients in our series who developed non-union were treated operatively on the 12th and 17th days after injury. Their neck fractures were Garden types III and IV, respectively. One patient with a Garden type II femoral neck fracture was treated on the 15th day and had satisfactory union. Non-union of the femoral neck may thus not only be a function of delay in treatment but also perhaps a function of the fracture type.

Kang et al. [12] reported two non-unions of the femoral neck in four cases of ipsilateral femoral neck and shaft fracture. Both femoral neck fractures were, however, initially missed. Others [3, 8, 11, 13] found the cephalomedullary nail to be useful in these fractures. In the present series, we had no varus mal-unions, not even in the Garden

Fig. 2 **A** Subtrochanteric fracture (type IA). **B** Unreamed femoral nailing with single proximal screw insertion, which was short and improperly placed. **C** Proximal screw back out at 15 months, with satisfactory union of the fracture

type III fractures. All fractures that united were classified as satisfactory unions, with all patients returning to their pre-injury functions. Thus, the cephalomedullary nail proved to be an adequate fixation device as it controlled both rotation and length in the comminuted shaft fracture besides stabilising the neck fracture.

For subtrochanteric fractures, the cephalomedullary nail has also been recommended by various authors [3–5, 8, 9] who cite the advantages of reduced bending moment, less frequent cut out, decreased infection rate and reduced blood loss. In our series, we obtained union in all cases, although we saw two cases where union was classified as being unsatisfactory. There was collapse at the fracture site and varus angulation with subsequent 1.5 cm shortening in one, and the other had pain in the hip associated with a Trendelenberg gait. Varus angulation has been reported to be a more common complication with the proximal femoral nail as compared to other intra-medullary implants [9]. Furthermore, the proximal screws backed out and were a cause of concern for the patients. These two complications were also reported by Herrera et al. [9] and were shown to be significant in comparison to other intramedullary devices. Accurate reduction of subtrochanteric fractures, particularly of the medial wall, is very important [3], and we agree that this is better achieved using the cephalomedullary nail than with other devices. Accurate placement of the proximal screws in the subchondral bone of the head [12] is also very important to prevent back out of the proximal screw. We believe that the two cases of screw back out from the femoral head that we observed were caused by improper placement and the use of screws that were too short (Fig. 2).

Last but not the least, the insertion of cephalomedullary nails is a demanding procedure, and the operative technique is complicated [7–9]. We encountered several intra-operative problems, as detailed in the Results section, which is in accordance with the reported literature [1, 8]. The problems were seen in the first few cases and were less common once we were familiar with the operative technique. Therefore, we believe that there is a learning curve with a steeper slope than in other nailing techniques.

In conclusion, we find that the cephalomedullary nail is a suitable fixation device for proximal femoral fractures and can be the first choice for ipsilateral fractures of the femoral neck and shaft and for subtrochanteric femoral fractures. Particular attention must be paid to the operative technique as it is complex and highly demanding, and intra-operative problems are commonly seen.

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